Evaluation of effectiveness of a 'Constructive approach of teaching' in learning and application of chemical formulae of ionic compounds among the 9th grade students

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ACKNOWLEDGEMENT

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Abstract

The objective of this research is to test the effect of a constructive approach towards students' understanding in writing the chemical formulae of ionic compounds. This quasi-experimental case study design research involves 79 students divided into two groups: one an experimental group (n = 41) and the other a control group (n = 38). The findings revealed that there were statistically significant differences between the experimental and the control groups, in favor of the experimental group. Our findings are based on both quantitative data (performance of students in tests) and qualitative data (collected through students' work). The findings proved that the constructive approach of teaching is more effective in assisting students to write and apply the chemical formula of ionic compounds. Students also have a positive perception towards the usage of constructive approach in teaching and learning activity. This study implies that the elements of experiential constructivism should be infused during the planning of teaching and learning to ensure that learning is more heuristic.

Introduction:

Mastering the symbolic representation is essential to understand the chemistry concepts and it is fundamental in writing the chemical equations. Students fail to explore chemistry when they face difficulties in writing chemical equations which arise from their inability to write formulae of chemical compounds correctly.

Although students are able to manipulate chemical formulae, they tend to solve it as a mathematical problem without understanding the concept behind it. So facing problems in retention of knowledge and use of it in writing the chemical equations.

Research Background:

The understanding of valency, appreciation of the concept of polyatomic ions and molecules

and ultimately the production of correct chemical formula depends on students' knowledge of bonding. Unfortunately, concepts in chemical bonding are highly abstract. Hence, a suitable pedagogical design is needed in visualizing the concepts involved in writing formulas of compounds. The researcher implemented the proposed action strategies by interventions to improve student's performance through designing student-centered constructivist approaches that help easily to avoid errors in writing the basic elements of Chemistry Language thereby developing confidence in how to easily learn chemistry concepts such as writing chemical formulae.

Objective:

1.To analyze the positive impact of new approaches in teaching and learning on students' understanding and achievement while increasing their involvement.

2. To analyze the positive impact of new approaches in teaching and learning on students' application of chemical formulae of ionic compounds

Research questions:

Is the constructive approach used as a learning tool in writing the chemical formula of ionic compounds more effective in increasing the students' knowledge, understanding and application than conventional teaching methods?

Research Hypothesis:

After the overall interventions and use of constructive approach of teaching, there will be significant improvement in knowledge, understanding and application of chemical formulae of ionic compounds among the 9th grade students.

Null () Hypothesis:

After the overall interventions and use of constructive approach of teaching, there will not be any significant improvement in knowledge, understanding and application of chemical formulae of ionic compounds among the 9th grade students.

Time Duration: 2 Months

- Preparation of action plan - 2 weeks
- Drafting of Pre-test, Post Test and Questionnaire Checklist - 2 weeks

- Interventions – 3 periods of 40 min each
- Administration of Post-test and the questionnaire-checklist to the respondent 2 periods.
- Data analysis, calculation and tabulation of result- 2 weeks
- Completion of research - 2 week

Population and Sample:

Population - Students of grade 9 from S. B. Patil Public School, Ravet affiliated to CBSE (Central Board of Secondary Education)

Sample -

41 students of grade 9 division E (experimental group) & 38 students of grade 9 division F (controlled group)

Research Design: Quasi- experimental case study design

Teacher compared the two group's (controlled and experimental group) performance on the pre and post questionnaire which will determine if one group performs significantly better than the other on the assessment based on pedagogy (constructivist classroom vs. traditional). Knowing what works best for students in the classroom will allow the researcher to improve teaching skills and will likely increase learning for students.

Variables of Study:

- **An Independent variable -** classroom pedagogy (constructivist classroom vs. traditional).
- **Dependent variables -** Pre-Test and Post-Test scores.

Tools of Data collection:

1.Pre-test and Post Test scores
2. Students Worksheets

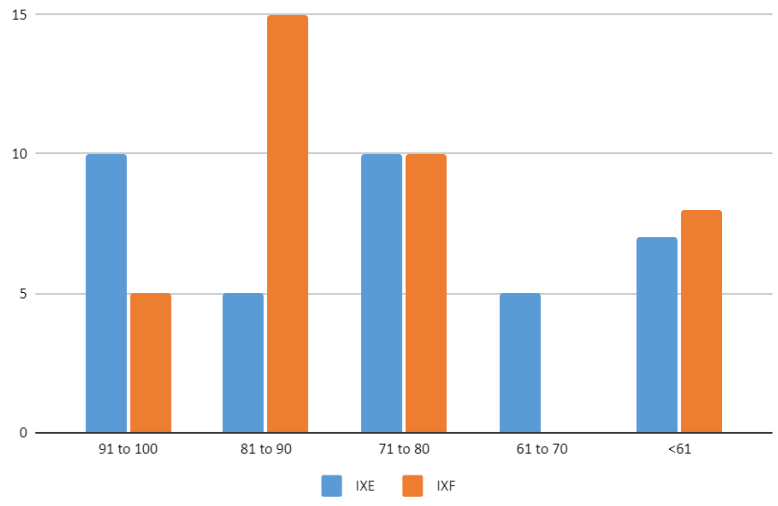
Two sections of grade 9 were enrolled in the study. The classes were selected randomly.

Table1 Number of students in each study group

Study Group	Grade & Div	No of students
Control group	9 F	38
Experimental group	9 E	41

Pretest- A pretest of 20 marks on the topics atoms, ions, molecules, valency was administered to both the experimental (IX E) and control group (IX F) as before their study of the chemical formulae to ascertain their prior knowledge on the topic. And to check if there is any significant difference between the two groups with regard to their academic achievement in the above topics.

Quantitative Analysis of Pre test		
	No. of students	**No. of students**
Criteria (%)	**IXE**	**IXF**
91 to 100	10	5
81 to 90	5	15
71 to 80	10	10
61 to 70	5	0
<61	7	8
	2 Students Absent	1 student Absent



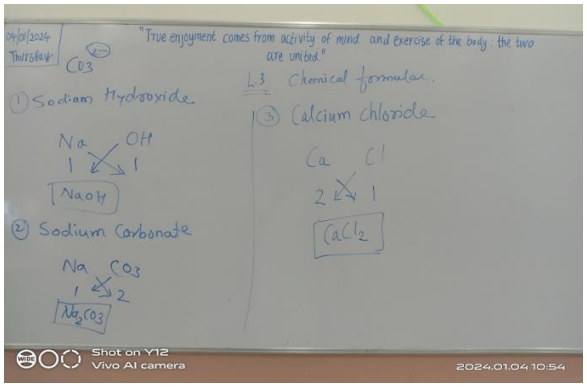
Tools of Data Analysis: Mean of Pre and Post test scores

Tools of Data Representation: Tables, Graphs, Charts

Interventions:

I) Traditional Method of Teaching- (For control group)

The students in the Control Group were instructed only with traditionally designed learning material. Textbook was used as a primary material. Most of the time, the teacher presented the topics and the students listened to their teacher and answered the questions asked by their teacher. Teacher explained many examples of chemical formulae. At the same time, they carried out activities in their text-books, solved some examples as homework practice.



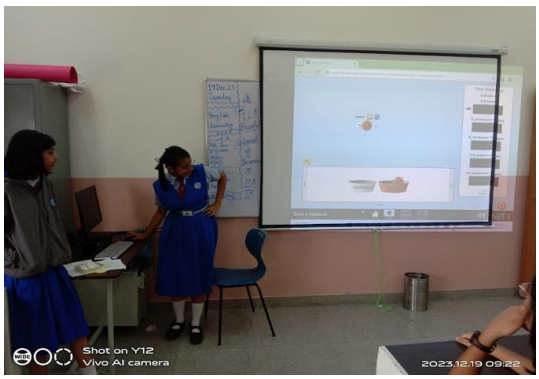
II) Constructivist Method of teaching -

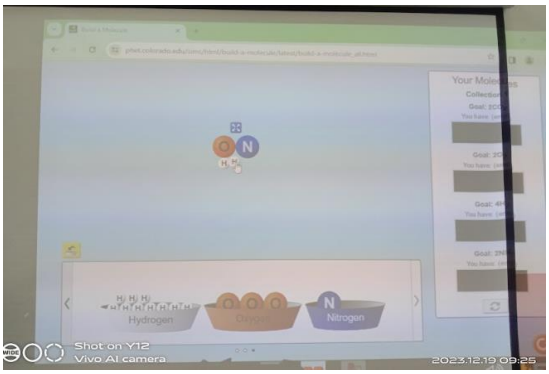
The constructivist classroom model suggests that constructivist lessons should **engage** students, allow them to **explore**, aid them in **explaining** their experience, learning is **elaborated**, and the lesson includes **evaluation.**

Five "E" Model -

1. **Engage** - https://phet.colorado.edu/sims/html/build-a-molecule/latest/build-a-molecule_all.html

Teacher used the Phet simulation to reinforce the students' understanding of ionic molecules. This simulation allows students to visualize how different molecules and compounds form. This activity is found to be an ideal way to engage students and ascertain their prior knowledge of atoms and molecules.

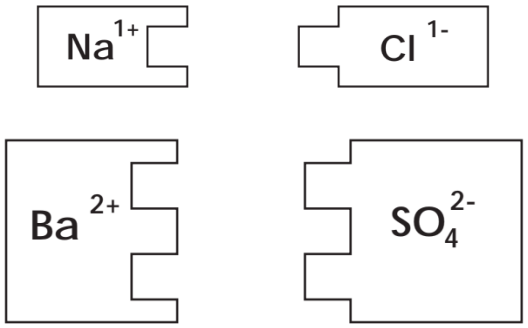




2. Explore - A hands-on activity called Jigsaw puzzles was introduced at this point.

Puzzles that represent the positive and negative ions were built and the formulae of the ions were written on the puzzles.

In the jigsaw puzzle game, students tried to solve the puzzle to form a rectangular shape figure. When students combined the puzzles with loops and heads to solve the puzzles, they visualized the combination of positive and negative ions to form neutral compounds.



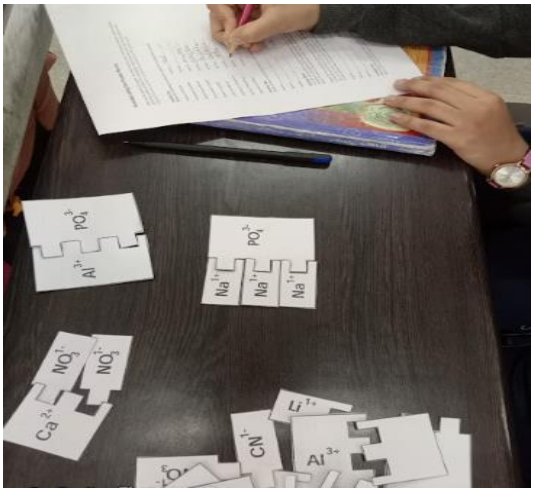
i) Activity one- Make the given compounds using the appropriate pieces:

Example-

Sodium Chloride formula _____

Potassium Bromide formula _____

Ammonium Nitrate formula _____

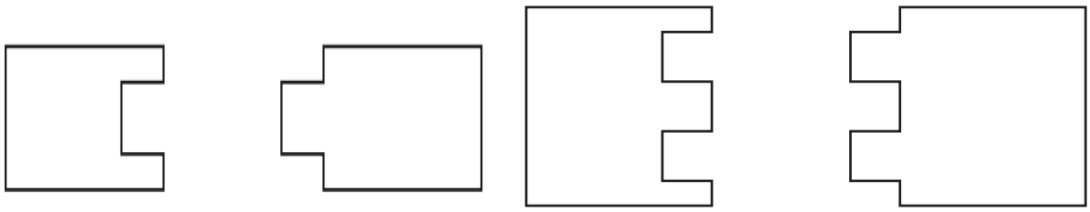


ii) Activity Two - Make some compounds of your own choosing and write the formulas:

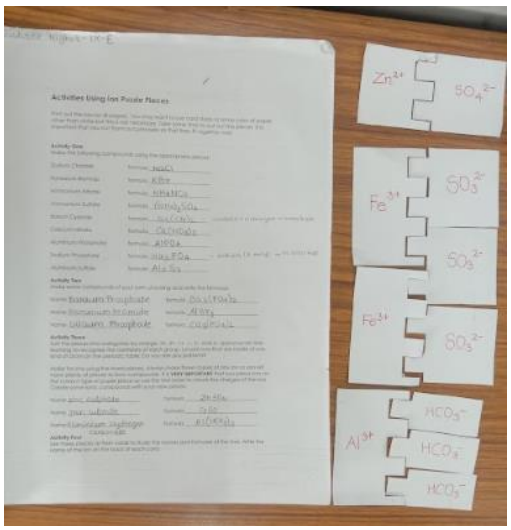
Name _____ formula _____
Name _____ formula _____

iii) Activity Three - Make the compounds using blank pieces.

Ask students to use blank pieces and make ions. Always make three copies of any ion so students will have plenty of pieces to form compounds. It is very important that students place ions on the correct type of puzzle piece so use the textbook to check the charges of the ions. Create some ionic compounds with the new pieces:



Name _____ formula _____
Name _____ formula _____

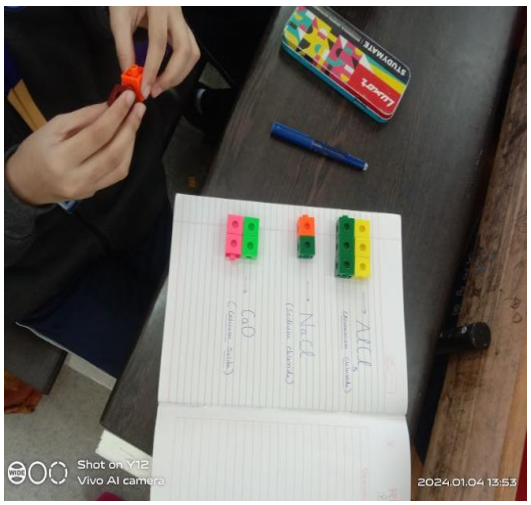


3. **Explain** - Students were encouraged to explain their own created ionic compounds with the new pieces in their own words, asked for evidence and clarification of their explanation, and listen critically to one another's explanation. Students used observations and recordings in their explanations. At this stage researcher provided definitions and explanations using students' previous experiences as a basis for this discussion

4. **Elaborate -**

i) A LEGO - based interlocking building block Activity.

During this activity student were encouraged to apply concepts and skills in new (but similar) situations of building a compound with LEGO blocks.

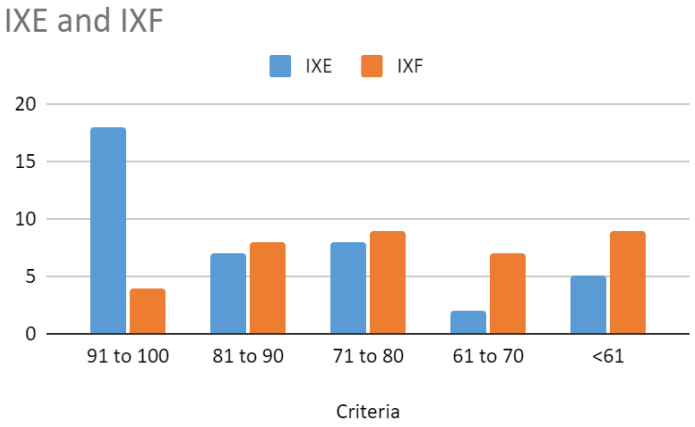


ii) Students were energized to apply the learned Chemical formulae to be used in chemical equations to describe chemical reactions, reactants and products.

5. Evaluate - Students cross checked their worksheets with other group students

Data Collection of Post test after Interventions-

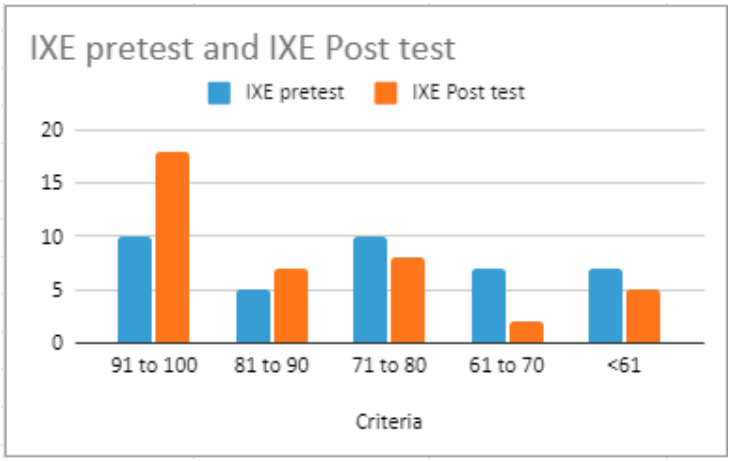
Quantitative Analysis of Post test		
	No. of students	**No. of students**
Criteria	**IXE**	**IXF**
91 to 100	18	4
81 to 90	7	8
71 to 80	8	9
61 to 70	2	7
<61	5	9
	1 Student Absent	2 Students Absent

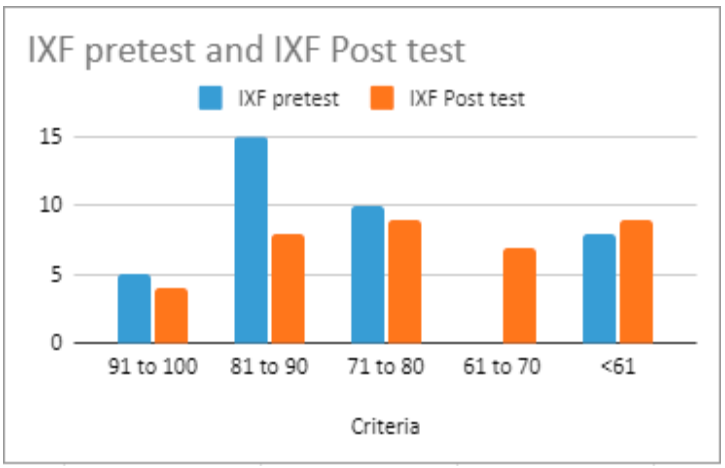


The following quantitative data compares the students' scores of pre and posttests.

Criteria	IXE pretest	IXE Post test
91 to 100	10	18
81 to 90	5	7
71 to 80	10	8
61 to 70	7	2
<61	7	5

Criteria	IXF pretest	IXF Post test
91 to 100	5	4
81 to 90	15	8
71 to 80	10	9
61 to 70	0	7
<61	8	9





Data Analysis:

1. Students in the Experimental group (IX E), who taught using a constructive method, showed a statistically significant increase in score on the posttest compared to the pretest, with a significant difference in outcomes between the two tests.
2. Students in the control group (IX F), who were taught using conventional methods, were unable to meaningfully answer the application-based problems. Consequently, demonstrating less development in the posttest.
3. Thus, the results reject the null hypothesis and accept the Research hypothesis to prove that after the overall interventions and use of constructive approach of teaching, there will be significant improvement in knowledge, understanding and application of chemical formulae of ionic compounds among the 9th grade students.

Major Findings:

1.This suggests that the Constructive method of instruction is useful in helping students grasp how to compose ionic complex chemical formulas. Visualization is therefore crucial to comprehending the ideas underlying the chemical representation.

2.The results demonstrate the potential potency and efficacy of a novel method for composing an ionic compound's chemical formula.

3.As a result, the experiential learning activity known as the constructive method of teaching may offer an engaging classroom setting that will pique students' curiosity and enthusiasm.

The findings of this study provide additional evidence for the value of experiential learning in piquing students' interest in picking up new concepts.

Conclusion - The constructivism approach gives students the opportunity to develop new knowledge from their visualization in writing chemical formulas of ionic compounds. From the students' feedback we can conclude that the innovative approach in writing the chemical formula of ionic compounds is accepted by students. The findings of this study support the positive impact of constructive approaches in teaching and learning on students' understanding and achievement while increasing their involvement.

In conclusion, the teaching and learning using the constructive approach in the topic of chemical formula assists the early learners in visualizing, understanding and applying the main concept underlies in writing the chemical formula of ionic compounds. Thus, preventing them from memorizing and accepting blindly formulas.

Take away-

This research implies that this constructive approach should be implemented in teaching and learning to improve the students' understanding in chemistry. For this, teachers should be well comprehended on the design and usage of the constructive approach as they play the main role of facilitators in teaching and learning. Finally, the insights gained from this research are expected to inculcate heuristic as well as thoughtful learning among the young chemistry learners.

Significance of the study: -

This research would be of great help for the teachers who would use the innovative techniques in their teaching for giving a good learning experience to the students.

Recommendation: -

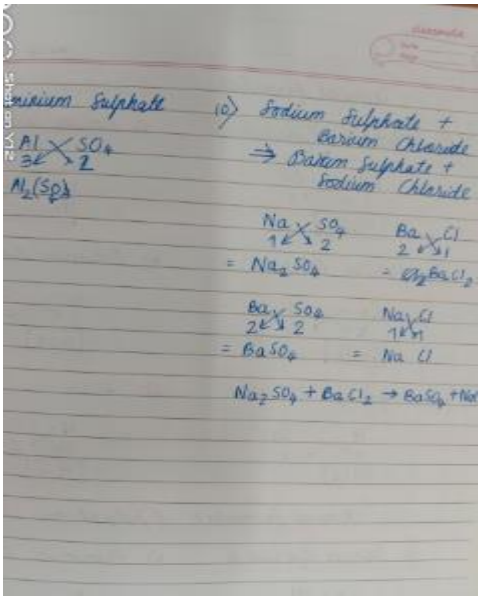
Henceforth, the same strategy could be used for the 9th Graders to enhance their visualization, understanding and application of chemical formulae.

References

1. Chaille, C. (2008). Constructivism across the curriculum: Big ideas as inspiration. Upper Saddle River, NJ: Allyn & Bacon
2. Constructivism in the Classroom- https://edpsych.pressbooks.sunycreate.cloud/chapter/constructivism-in-the-clasroom/
3. Constructivism: learning theories and approaches to research- Anna MacLeod

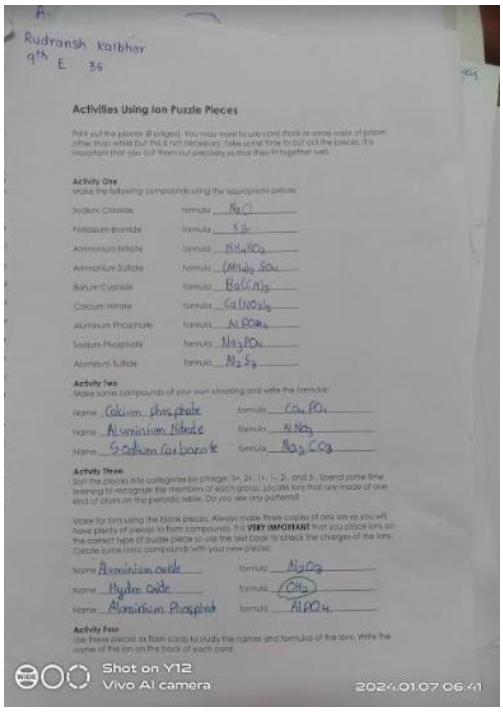
Annexure 1

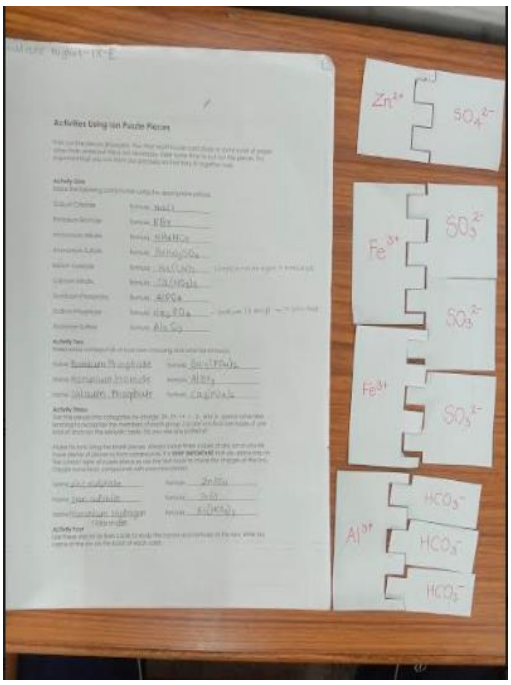
Traditional Method of Teaching-



Annexure 2

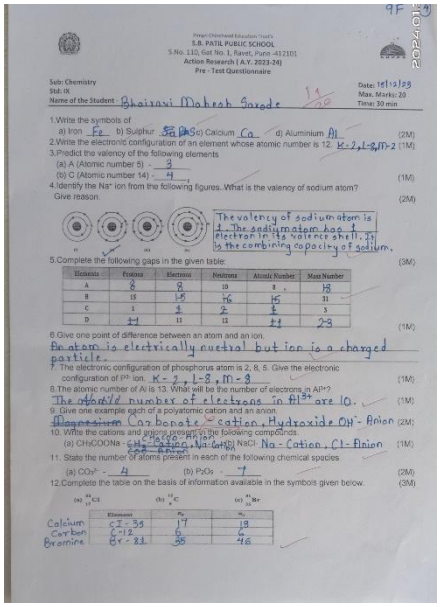
Worksheet of jigsaw puzzles

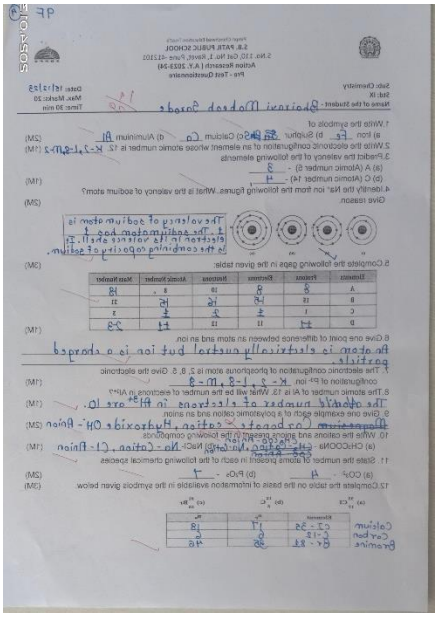




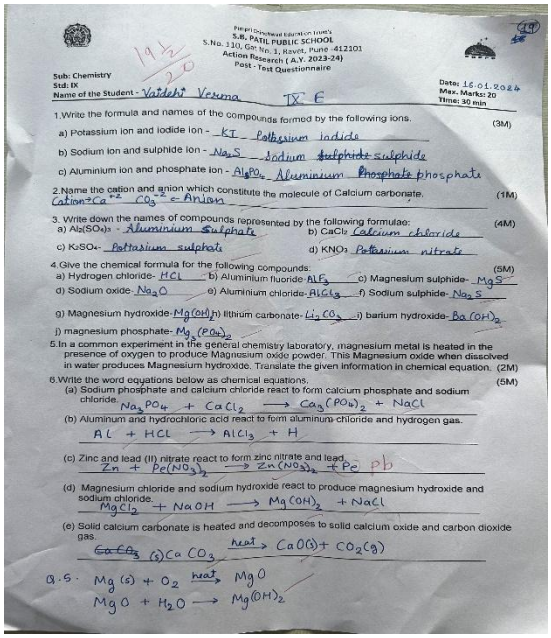
Annexure 3

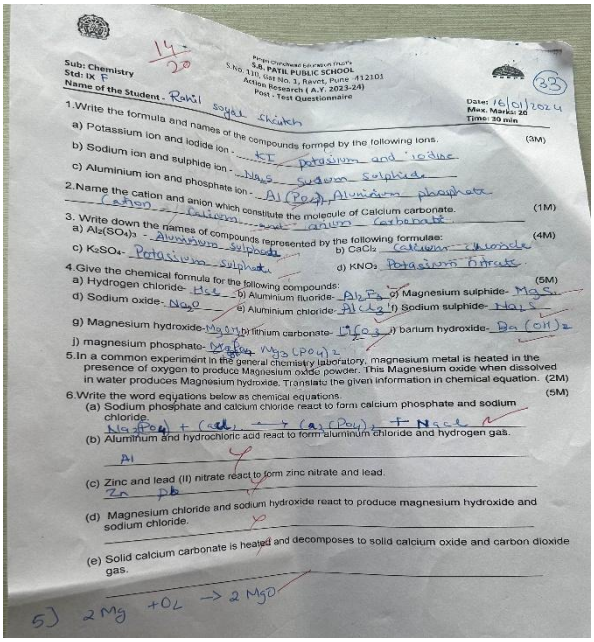
Answer sheet of Pre-test





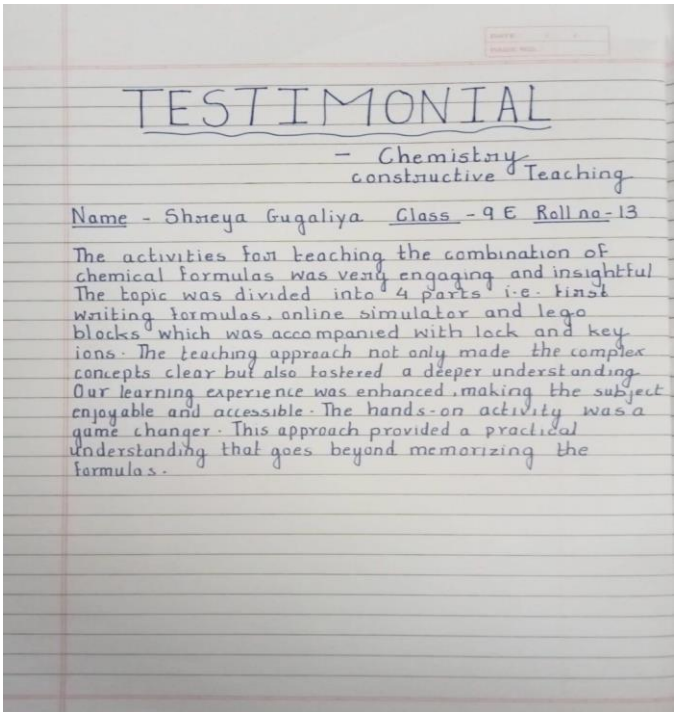
Answer sheet of Post-test





Annexure 4

Students Reflection

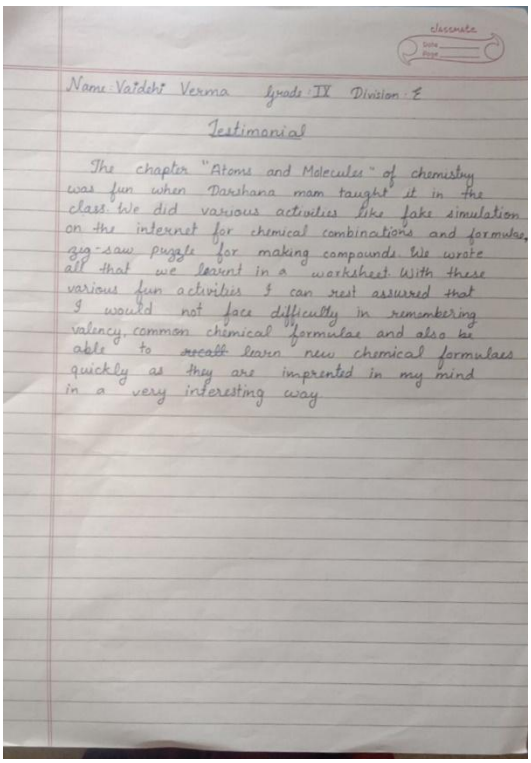


TESTIMONIAL

– Chemistry constructive Teaching

Name - Shreya Gugaliya Class - 9 E Roll no - 13

The activities for teaching the combination of chemical formulas was very engaging and insightful The topic was divided into 4 parts i.e. first writing formulas, online simulator and lego blocks which was accompanied with lock and key ions. The teaching approach not only made the complex concepts clear but also fostered a deeper understanding. Our learning experience was enhanced, making the subject enjoyable and accessible. The hands-on activity was a game changer. This approach provided a practical understanding that goes beyond memorizing the formulas.



Name: Vaidehi Verma Grade: IX Division: E

Testimonial

The chapter "Atoms and Molecules" of chemistry was fun when Darshana mam taught it in the class. We did various activities like fake simulation on the internet for chemical combinations and formulas, zig-saw puzzle for making compounds. We wrote all that we learnt in a worksheet. With these various fun activities I can rest assured that I would not face difficulty in remembering valency, common chemical formulae and also be able to recall learn new chemical formulaes quickly as they are imprented in my mind in a very interesting way.

Indicators for teaching effectiveness

Questions Responses 18 Settings Total points: 0

no

It was a great activity, it helped me in understanding about the chemical formula topic as it was very interesting and engaging activity. More such activities should be conducted by the school.

The topic first introduced by the activity form and then encountered with solving problems helped better understanding rather than passively memorizing formulae.

No

Explained very perfectly in fact I don't have to take stress about chemistry

The activity was very interesting and got to known how to make thee chemical formulae by using the blocks of the elements.

It was interesting activity. I understood that hard concept very easily, now I can solve questions related to topic Chemical formulae